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ABSTRACT

Described is a prototype computer assisted teacher training system (CATTS) to provide continuous immediate feedback to teacher trainees. The importance of immediate feedback in teacher education is discussed. Advantages of CATTS are explained to include the adoption of a broad spectrum of observable teacher and pupil behaviors, and the rapid cumulative storage and retrieval of all training sessions. Preliminary support for the efficacy of CATTS as a training tool for teachers of the educable retarded is reported. (CL)

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TOWARD THE DEVELOPMENT OF A COMPUTER-ASSISTED TEACHER TRAINING SYSTEM (CATTS)

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TECHNICAL REPORT 7.2

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TOWARD THE DEVELOPMENT OF A COMPUTER-ASSISTED TEACHER TRAINING SYSTEM (CATTS)

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Abstract

The utilization of observation-coding systems as a teacher training tool is generally limited because tedious procedures for processing data result in delay of feedback to trainees. The importance of immediate feedback in the training of teachers is discussed. A prototype computer assisted teacher training system (CATTS) is described. Classroom behavior is directly coded and transmitted in "real-time" to a computer for data analysis. The computer and associated hardware and software configurations provide continuous immediate feedback to the trainee in the classroom. Preliminary research and development activities are briefly described.

TOWARD THE DEVELOPMENT OF A COMPUTER-ASSISTED TEACHER TRAINING SYSTEM (CATTS)

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This brief communication outlines an approach for applying computer technology to teacher training and the study of teacher-pupil interactive behavior in classrooms. While exploration of many of the ideas discussed projects into the future, prototype developments and research activities have already been conducted by the author and his associates (Semmel, 1968), and are currently being continued at the Center for Innovation in Teaching the Handicapped (CITH) at Indiana University. Space does not permit detailed description nor explication of these developments. Extensive documentation of configurations and activities is available through CITH (Semmel, Olson, & Weiske, 1971).

Overview: Toward Developing a Skill Oriented Training Program

Teacher training programs differ in their orientations to developing appropriate skills among their trainees. However, there appears to be an agreed emphasis on the importance of practicum experiences in the training process (Peck & Tucker, 1971). Direct contact with children is thought to be more valuable than vicarious exposure through lectures and discussions about the teaching process. John Dewey's well worn admonition, "learn by doing" is almost universally accepted (if not practiced) by teacher educators. However, simply providing trainees with an opportunity to teach in a practicum environment without appropriate feedback does not insure the acquisition of specific teaching

skills any more than do lectures or discussions in a university methods course.

The process of acquiring appropriate teaching skills is defined by the ability of trainees effectively to discriminate, generate, and evaluate behaviors, patterns, and teaching environments (Hunt, 1971). The task for university training programs is to teach adults (i.e., train teachers) to demonstrate specific teaching skills. Specification of training objectives should make it possible to test empirically the hypothesis that the achievement of training criteria is effective in facilitating pupil learning (Rosenshine, 1970 (a), (b), (c); LeBaron, 1969).

Peck and Tucker (1971) have outlined a series of steps which describes a "system" for developing effective teaching skills. The system calls for the precise specification of the behavior to be learned, carefully planned training procedures designed to achieve the objective, the measurement of the results of training in terms of the behavioral objective, feedback to both the learner and the trainer, and recycling through the training procedure until reaching criterion.

The Peck and Tucker model characterizes an ideal sequence for contemporary teacher training programs. It should be pointed out, however, that the sequence of steps proposed is as much determined by a set of unverbalized methodological constrictions as by philosophical or empirical convictions. For example, the model assumes that feedback must follow measurement of results, which in turn must follow training procedures. If, on the other hand, results and feedback could be achieved concurrently with training, such methodology would appear to be a potentially optimal extension of the theoretical substrate that pro-

duced the sequential paradigm. However, there is obviously a number of practical problems in achieving these training facets concurrently. The measurement of the effects of training traditionally has taken place after the observation of trainee performance. It generally has required recording, summarizing, and analyzing results following performance. Feedback to a trainee classically has assumed that summative procedures are necessary, since formative feedback procedures during training require an effective delivery system to the trainee (or trainer) which would not interfere with the performance being assessed.

The Importance of Immediate Feedback

Assuming a methodological sophistication which permits the measurement and feedback of results of training concurrent with the performances of trainees in practicum settings, there arises the question of the ability of trainees to utilize knowledge of results while simultaneously being engaged in attempts to practice specific teaching skills. The work reviewed by Broadbent (1958), and Swets and Kristofferson (1970), offers some theoretical and empirical support for the contention that the human adult has the requisite information processing competence to recode simultaneous multiple messages.

Heinrich and McKeegan (1969) reported that discrepancies between teachers' beliefs about how they were acting and how they were observed to act were less pronounced when subjects received concurrent immediate supervisory feedback as compared to delayed feedback relative to teaching behavior. The concurrent immediate feedback condition was delivered by the supervisor who raised color-coded cards whenever a desirable or undesirable teacher behavior occurred.

Reddy (1968) demonstrated that counseling trainees who received im-

mediate supervisory feedback through a dictaphone earplug device improved significantly more in empathic skills than those who received either delayed or no feedback. Spaulding (1971) similarly reported that in-service teachers who received a variety of feedback experiences showed greatest improvements under a condition employing immediate feedback during classroom instruction periods. The immediate feedback from the observer was transmitted by means of a wireless audio receiver and ear speaker. It should be emphasized that in these studies the feedback provided to trainees was instantaneous and occurred during rather than after the training sessions. The work cited, therefore, offers empirical evidence for the contention that teachers in training can process and utilize feedback information while attempting to acquire specific teaching skills.

The importance of immediate knowledge of results or feedback in the learning process has been well documented. Greenspoon and Foreman (1956) have reported that delayed feedback, compared to immediate feedback, has a negative effect on human learning on a simple motor task. Tasks involving verbal skills appear also to be facilitated through the immediacy with which feedback can be provided (Bourne, 1957). Some workers have gone so far as to contend that feedback might well be the "strongest" and "most important" variable involved in learning and performance (Bilodeau & Bilodeau, 1961).

Hence, the human learner may be viewed as a self-regulating cybernetic system who relies on feedback in his efforts to maintain goal-directed behavior (Smith & Smith, 1966; Semmel, 1968). The more rapidly the learner can receive feedback, the more rapidly he can be expected to modify his behavior in the direction of discriminable objectives--and,

thus, increase his efficiency in the acquisition of teaching skills (Gibbs, 1954).

Observation Systems in Teacher Training Programs

It is evident that the stipulation of what constitutes relevant teaching skills must be developed within the context of a comprehensive philosophical or empirical framework of that which is hypothesized to positively effect pupil learning. The most relevant objectives in training will probably be those which go beyond the simplistic notions of trainee discrimination and generation of a specified frequency of X or Y behaviors. It is more likely that a training program will need to be concerned with complex interactive patterns of classroom behaviors and with the concatenation of these patterns into operational definitions of desired pedagogical environments.

A number of observation-coding systems have been developed by educators interested in describing relevant teacher-pupil interactions in classrooms (Simon & Boyer, 1970; Medley & Mitzel, 1963). The categories used in these systems constitute operational definitions of what the designers deem to be important classroom processes. When teacher-trainees are encouraged to favor one subset of behaviors or patterns from the total set of categories defining the system, it may be said that a program has established specific behavioral objectives for the trainee. When trainee performance is observed systematically and the codified behaviors are fed back to trainees, the system may be thought of as being a functional teacher-training tool (Amidon, 1970; Bondi, 1970; Flanders, 1970).

Observation-coding systems have an intrinsic appeal to teacher

educators. They (a) establish a set of operationally defined behavioral objectives for the trainee; (b) generally suggest an implicit set of training procedures leading to direct practicum experiences for trainees; and (c) generally provide a set of ground rules which permit reliable measurement of trainee progress. Existing systems vary greatly in their specificity of teaching behaviors. Some focus on the affective climate of the classroom (Flanders, 1970), while others focus on the cognitive demands made by the teachers (Lynch & Ames, 1971), teacher control behaviors (Fink & Semmel, 1971), teaching strategies (Bellack, Kliebard, Hyman, & Smith, 1966), non-verbal behaviors (Galloway, 1968), and a host of other interactive skills.

While ideally suited to the requirements of a skill-oriented training program, observation systems are subject to limitations as operational tools for teacher training programs. They require extensive time commitments on the part of trainers who, after assisting trainees in discriminating operational objectives, must observe, code, summarize, analyze, and subsequently feed back the results of performance to trainees. Hence, the total training process becomes tedious, and the excessive time commitments seriously limit the feasibility of such an approach.

Secondly, analytic methods available to the trainer generally prohibit feedback of relevant patterns of interaction beyond the frequencies of simple two-stage transitions. Methods of data reduction frequently lead to distortions of the frequencies of behaviors for specific periods (Collet & Semmel, 1971). Of greatest importance, however, is the fact that current methods necessitate relatively long delays of feedback to trainees. Hence, as implied by the literature previously reviewed, it is questionable that the information provided to trainees could have

maximum effects on the modification of subsequent teaching performance.

Exploiting Computer Technology in Teacher Education

The introductory sections of this communication emphasize the importance of immediate feedback to the acquisition of relevant teaching skills. Observation systems were discussed as potential operational tools for the specification of training objectives, as feedback instruments in training, and as tools for the measurement of trainee performance. The utility of such observation-coding feedback systems is severely limited by the tedium imposed by data reduction procedures and resulting delay of feedback to trainees. It would appear that there is a need to explore a skill-oriented teacher training system which meets the following criteria:

(a) permits the adoption and/or generation of a broad spectrum of observable teacher and/or pupil behaviors--to be definable within the context of any system of N mutually exclusive categories of behaviors.

(b) permits the continuous and instantaneous observation, coding, analysis, and feedback of relevant training information to the trainee while he is teaching--with feedback delivered through some meaningful auditory or visual source within the teaching environment.

(c) permits the utilization of automatic analytic techniques for the continuous, rapid synthesis and description of relevant behaviors, patterns, and environments--while maintaining both the frequency and duration of behaviors as well as their sequential relationships.

(d) permits the rapid cumulative storage and retrieval of all training sessions for any one trainee or group of trainees who uses the system.

One of the most promising means for meeting the above criteria is through the exploitation of "real-time" computer technology. What follows is a brief description of a prototype computer-assisted teacher training system (CATTS) which is currently under development at our laboratory.

What is CATTS?

CATTS is conceptualized as a closed-loop cybernetic system capable of producing continuous immediate feedback of relevant teacher-pupil interaction data to the trainee in the classroom, so that modification of behavior can be realized through regulatory teaching moves in accordance with predetermined objectives.

The prototype CATTS configuration presently consists of three interdependent stations: Teaching Station, Observation-Coding Station, and Analysis-Encoding Station. Figure 1 (p. 9) illustrates this configuration with a schematic diagram of the present CATTS installation at Indiana University's Center for Innovation in Teaching the Handicapped (CITH).

Teaching Station. The Teaching Station consists of a classroom or classrooms which can accommodate a feedback device. The feedback source is located so that the teacher can use the information contained as required, with no interference with on-going classroom activity. The feedback display may be either visual or auditory in nature, controlled either directly by the computer or indirectly through external display hardware.

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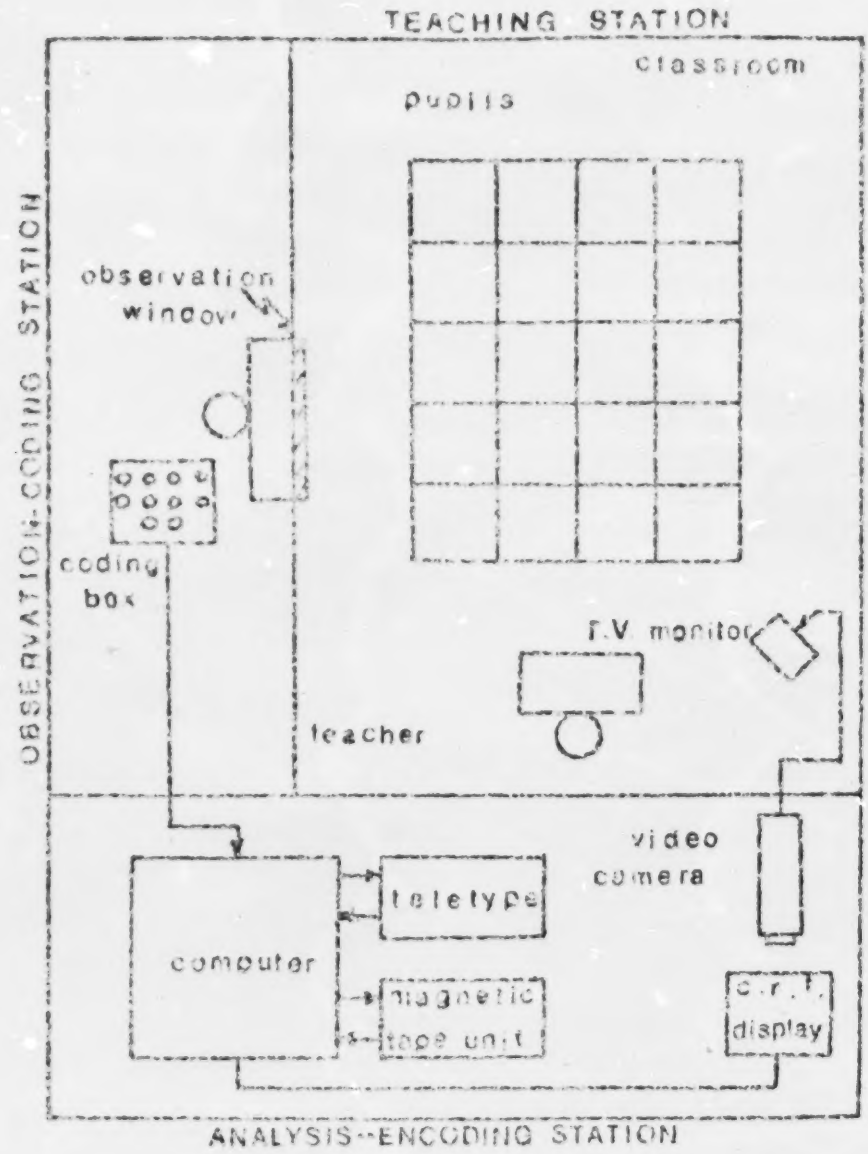

Fig. 1. Schematic diagram of present conceptual arrangement of CAITS stations.

Current developments permit the delivery of a variety of visual displays to the Teaching Station. Visual feedback can be provided through closed-circuit, televised images of a cathode-ray tube (CRT) display under direct computer control, or an external device which displays feedback information by changing light patterns, or x-y chart recordings (Semmel, 1968; Semmel et al., 1971; Van Every, 1970).

Instantaneous auditory CATTS feedback will be available in the near future. We plan to link our PDP-12 computer to an audio tape recorder head capable of moving rapidly across a tape of pre-recorded messages containing verbal feedback relevant to specific teaching behaviors and patterns. For example, if teacher talk (as computed from a number of behavioral categories) exceeded a predetermined criterion (e.g., 80 percent within a particular time period), the computer could automatically "direct" the tape head to locate the tape message which says, "Try cutting down teacher talk, and get more pupil participation." While teaching, the trainee would receive the message via a wireless, transistorized, audio receiver with earplug speaker. The specification of the parameters for performance criteria through computer programing will assure error free monitoring of trainee behaviors. The resulting CATTS feedback should, therefore, be more reliable than supervisor feedback methods (Spaulding, 1971).

Observation-Coding Station. The Observation-Coding Station provides the link between the events occurring in the classroom and the computer analysis of these events. Here a trained observer codes classroom events consisting of N categories of teacher and/or pupil behavior. Observation may take place within the classroom itself, within an observation booth adjoining the classroom, or by a closed circuit television connection.

At present, the coding terminal used to input observation data consists of ten mechanical pushbuttons mounted on a metal box--a configuration similar to a touch-tone telephone. These buttons, in turn, interface directly with the computer.

It should be noted that the terminal permits observers to code all behaviors observed. There is no need to impose fixed time intervals for coding the sequential classroom behavior, since the computer automatically records frequency and duration data as input is received.

Probably the greatest asset of the button-box coding terminal is that it can accommodate any observation system whose classification scheme can be defined by a series of numbers. The number of categories that can be accommodated is virtually unlimited.

The present computer program is capable of accepting a three-stage classification scheme with a maximum of 15 different codes per stage. Hence, we are currently able to record, in addition to categories and subcategories, the interactions between teachers and specific children in a classroom.

Analysis-Encoding Station. The Analysis-Encoding Station consists of a small computer (PDP-12) and the associated computing hardware required for the on-line processing of coded input data which is gathered and transmitted from the Observation-Coding Station. Presently, our PDP-12 computer can process simultaneously input data from three different classrooms. In the near future it will be capable of processing data from as many as 12 classrooms, simultaneously accepting data from more than one type of observation system.

In addition to processing input, the computer system also controls the display devices used in the teaching stations and provides for hard-

copy printout, storage, and transfer of the analyzed data. It is at this station that the trainer initiates the program options available in CATTS. The teleprinter console, through software program control, allows the operator to select any specific CATTS program or option that will satisfy the objectives of the trainer and/or trainee.

The selection of the mode and content of feedback to the teacher-trainee in the teaching station is also initiated from the console. If a CRT display is chosen as the method for feedback, the operator determines the content of the display by assigning the input data to different computational functions for the computer to calculate and display as feedback. The nature of the display is also selected from the console which allows continuous feedback information to be presented either in alphanumeric or graphic form. The completion of the input-feedback cycle is realized in a matter of a few microseconds. Feedback displays can vary from simple frequency counts of desired behaviors, to abstract representations of sequential interaction patterns.

The integrated teleprinter, which also serves as the communications link to the CATTS program, provides hard-copy printouts for inspection immediately following the training session. These printouts can provide such information as the event times of the coded tallies, percent of time spent in each behavior category, and frequency of occurrence of each category, or can provide more complete descriptions and statistical treatments of the data. This information can be used as "delayed feedback" to a trainee, and can be stored for later analysis. It should be noted that the use of the term delayed feedback in the present context is generally defined as immediate feedback by most teacher-trainers (Baker, 1970), since computer printouts are available to trainees im-

mediately following their CATTS training session.

By using the computer in this manner, bits of observation system data are not limited only to storage by frequency and time of occurrence. The duration of behaviors, and their order of occurrence is also recorded in the computer's memory, and subsequently on paper-punch tape or magnetic tape for analysis. With CATTS we can collect a continuous data record of classroom events, allowing analysis of duration of behaviors, as well as analysis of patterns or chains consisting of up to eight behavior categories. Hence, rapid description and analysis of a continuous sequential vector of observational data can be analyzed and fed back to trainees (Collet & Semmel, 1971).

In summary, it rapidly can be seen that the translation of the closed-loop cybernetic principle is achieved through the prototype CATTS by using a human observer-coder as the interface between the events in a practicum setting and a computer. Behavior in the Teaching Station is observed in the Observation-Coding Station and transmitted to the Analysis-Encoding Station. In a matter of microseconds, the computer summarizes, analyzes, stores, and continuously feeds back relevant information directly to the trainee in the classroom. The system also provides a comprehensive printout of the analysis of all variables coded in the observation of the classroom transactions which may be used as summative feedback following a training session or stored for subsequent recall or analysis.

Other Training Applications of CATTS

CATTS is not limited to the delivery of instantaneous or delayed feedback to trainees, nor to rapid data collection, retrieval, and

analysis. The possibility of using videotapes in conjunction with the system was considered in developing a computerized technique for training students to discriminate relevant behaviors and for training reliable observers. The consensus coding system (CONCODE)[1] requires two or more trainees to observe a videotape of classroom activity. Utilizing the same observation-coding system, the observers enter their codes through button-box terminals to the computer. When a coding consensus is not attained, the computer stops the videotape, records the differences, and "refuses" to move on until the trainees discuss their differences and reach a consensus.

Through CONCODE, we hope to extend the teacher training capabilities of CATTS as well as train reliable observers. CONCODE can be used as a vehicle for developing trainee attitudes about observed classroom behaviors. The computer can act as an impartial "discussion leader" by pointing out to trainees where and when they differ in their attitudes, perceptions, etc., and can be programed to wait for differences between trainees to be reconciled (Semmel et al., 1971).

Preliminary Research and Demonstrations with CATTS

Actually, CATTS is just a kitten. Hence, many modifications have yet to be implemented through research and demonstration projects. Obviously, the most pertinent question is whether the system does in fact have the capability for developing and modifying specific teaching

[1] A prototype version of this system was developed in the writer's laboratory at the University of Michigan in collaboration with L. Guess and N. Flanders.

skills. It can be reported with a degree of confidence that the system eliminates the tedium of coding, summarizing, and analyzing data associated with traditional approaches to observation systems. As such, it has obvious advantages as a research tool. However, the efficacy of CATTS as a training system remains to be empirically demonstrated.

Four preliminary investigations were completed by the writer's students at the University of Michigan during 1969. Schmitt (1969) and Kreider (1969) attempted to demonstrate significant positive effects of CATTS in training college juniors aspiring to teach the mentally retarded. Trainees attempted to increase the use of specific categories of behavior in two content areas defined in a modification of the Flanders Interaction Analysis System. Schmitt focused on increasing trainees' uses of broad questioning behavior and on reducing the frequency of binary questions in a class for the educable mentally retarded (EMR). Kreider, on the other hand, attempted to increase trainees' uses of pupil ideas in a class for EMR pupils. Kreider's results offered only limited support for CATTS training effects. However, with a limited number of subjects and training trials, Schmitt's findings were very encouraging. As hypothesized, the results indicated that CATTS trainees spent significantly more time asking broad questions than did control trainees. Descriptive analysis also revealed a positive relationship between teachers' uses of broad questions and the production of broad responses (multiple word utterances) of their EMR pupils. This study pointed to a number of complex interaction effects and problems of transfer which require future exploration.

Weaver (1969), a third member of the CATTS group, studied how preconceived expectations about EMR children affected the modification of

trainees' uses of pupil ideas. The results did not support unequivocally the superiority of CATTS feedback, although CATTS subjects did demonstrate greater gains when compared to trainees who received the delayed feedback condition.

Additional support for the efficacy of CATTS was obtained by VanEvery (1970) who brought the system out of the laboratory and into a practicum environment. In this study, a remote telephone line was used to communicate between a speech clinic training site and our CATTS laboratory. Observations of therapists in training were coded in the clinical setting and transmitted by telephone line to our computer (in real-time). The feedback provided to trainees by the computer was delivered through an event recorder which traced a pattern, representing the training objectives, on a moving belt of paper within the clinical setting. The results clearly revealed a significant increase in the use of social reinforcement (SR) patterns of trainees who received CATTS feedback when compared to a contrast group. Learning curves revealed increments for all trainees in the use of SR modeling patterns, but CATTS trainees improved significantly more than the "no-CATTS" trainees.

VanEvery's work has demonstrated the feasibility of eventually moving CATTS into public school classrooms for <u>in situ</u> training opportunities. In the near future it may well be cost-effective to develop comprehensive regional CATTS installations for in-service as well as pre-service teacher training programs. The use of touch tone data sets and telephone lines currently permits communications between classrooms in the community and centralized computer facilities. The cost effectiveness of such a system might be improved considerably through the eventual

use of transponders on communication satellites (Jamison, Ball & Potter, 1971) and other promising hardware and software configuration developments (Jamison, Fletcher, Suppes & Atkinson, 1971).

The prototype system on which the initial CATTS studies were executed further has been developed and expanded in our CITH laboratory at Indiana University. The system presently monitors and provides continuous feedback to three classrooms some distance from the main analysis-encoding station. Several investigations are currently underway within the context of a Special Education methods practicum for undergraduate trainees. The effects of different feedback conditions on the acquisition of questioning skills by teacher trainees are being assessed. The impact of CATTS feedback on questioning behavior of trainees is being studied under both classroom and simulated (role playing) conditions. We are also using the system in developing behavior management skills of prospective special education teachers. CATTS' potential for simplifying the process of classroom observation coding for research purposes also is being demonstrated in several studies at our Center. For example, the system is used to record and describe simultaneously the behavior management and cognitive demand strategies of teacher trainees in the classroom, in an attempt to relate interactive patterns to the achievement of mentally handicapped pupils .

Preliminary results of our current work, together with indications from earlier research, are encouraging. The future utility of CATTS as a teacher training tool will depend largely on the outcome of long term controlled studies of its effect on trainee skill acquisition and on the ability of the system to assist trainees in the generation of those teaching patterns and environments that optimize pupil growth. We are

confident that, with creative application of psycho-educational principles and continuous development of the available technology, a cost-effective CATTS system can be realized in the near future.

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